

EXPLANATION OF PLATE 43.

- Fig. 1. Colony (without attachment) (nat. size), showing the unilateral method of branching; also a part of the axis devoid of cœnenchyma, showing the ridges and furrows; also the internodal origin of the branches.
2. Typical colony (nat. size), showing the palmate terminations of the twigs.
3. Tip of a branch ($\times 10$) with one half cut away, showing (i) the excessive thickness of the cœnenchyma; (ii) the longitudinal nutritive canals; (iii) the retracted polyps sunk in cavities in the cœnenchyma; (iv) the enormous embryos *in situ*; (v) the thick muscular bands.
4. Part of the surface of the cœnenchyma enlarged ($\times 14$), to show the polyps in different stages of retraction, with the small mound-like elevations.

Notes on some Species of *Nereis* in the District of the Thames Estuary. By H. C. SORBY, LL.D., F.R.S., F.L.S.

[Read 1st March, 1906.]

FOR more than 20 years I spent four or five months each summer (May to September) on board my yacht 'Glimpse' in various parts of Kent, Essex, and Suffolk, devoting myself much to the study of the marine animals. During this time I was able to observe a number of interesting remarkable facts connected with the *Heteronereis* form of two species of *Nereis*, which occur rarely.

Except in a few rare cases, when properly mounted in balsam, the natural colour is to a great extent preserved, and it is quite easy to see the form and colour of the jaws, even when completely retracted, and the form and colour of the prickles about the head, and of the eyes, as seen by transmitted light, and the ova, when present, which is not the case when specimens are preserved in alcohol or formalin.

The species found by me in the district of the Thames estuary are as follows:—

1. *Nereis diversicolor*, Müller.—Often very common in the mud of the estuaries left dry at low water, but rare in some of them.
2. *N. Dumerilii*, Audouin & Milne - Edwards.—Living in tubes formed amongst the marine plants. It must be numerous in some localities, but often lost when the plants are dredged up.
3. *N. longissima*, Johnston.—Very rarely found in the mud, but must be fairly common in some places.

4. *N. pelagica*, Linn.—At one time was common off Harwich amongst the sandy tubes built by *Sabellaria spinulosa*, Lamarck.
5. *N. cultrifera*, Grube.—Common in the mud at low water in particular localities, especially at the mouth of the Colne and off Harwich.

When mounted in balsam these species can be at once distinguished from one another by the following characters:—

1. *N. diversicolor*.—Numerous small black prickles about the head.
2. *N. Dumerilii*.—Unusually long tentacular cirri. Eyes black and very large for the size of the animal, those of each pair very close or even partially coalesced. Prickles almost or quite invisible.
3. *N. longissima*.—Prickles very obscure or invisible. Eyes pale brown by transmitted light. Tentacular cirri short. Jaws dark-coloured, with rounded teeth.
4. *N. pelagica*.—Numerous prickles of varying size and somewhat rounded shape, of pale brown colour by transmitted light.
5. *N. cultrifera*.—Unusually large black angular prickles. Many small blood-vessels perpendicular to the length of the parapodia.

One great advantage of these characters is, that they apply equally well to the *Nereis* and *Heteronereis* state, and can be seen at once without injury to the specimen.

I have found only one specimen of *N. longissima* in the *Nereis* condition, obtained in the mud of the Orwell at Pin Mill, which is 7 inches long and over $\frac{1}{4}$ inch thick. When put into diluted formalin, it broke itself into two, which I never knew happen in the case of any other species. I have seen and caught it in the *Heteronereis* condition on only two occasions. The first was off Sheerness, in the evening of May 11th, 1882. I saw round the yacht large numbers of what I thought were small red fish swimming near the surface at the rate of several miles an hour; and, on catching some, was astonished to find they were worms about $4\frac{1}{2}$ inches long. On putting some into my large aquarium, a small *Pandalus* seized one two or three times as large as itself and carried it down to the bottom. The second occasion was late in

the evening of Sept. 9th, 1889, at Queenborough, where numbers were swimming about us. Unfortunately only four specimens were preserved, since I expected to collect more the next day; but though I carefully looked for them in that and subsequent years, I never saw another. I also never found one in the mud, and do not know exactly where they or the *Nereis* form live permanently in the district of Queenborough. Some of the specimens are small, being only two inches long, and one differs so much from the rest that at one time I looked upon it as a different species.

The case of *N. Dumerilii* is still more remarkable. I have lived several weeks, nearly every summer, for many years on the Stour and Orwell, and though carefully looking out for anything swimming near the surface, I do not remember seeing a single specimen of the *Heteronereis* except on July 16th, 1898. When I went on deck at 5 A.M. in Harwich Harbour, great numbers were swimming around as far as could be seen, and I was led to conclude that they extended over such a wide area, that possibly the total number was something like a million. None could be seen two hours later. They were of small size, the largest caught being not quite an inch and a half long. The remarkable fact is, that such numbers should come to the surface at nearly the same time, over a considerable area, and swim about for a few hours and suddenly disappear without any apparent cause. As far as I and Professor Denny have been able to make out, all were males, and I did not see any ova voided from the considerable number of specimens collected and kept alive in sea-water for several hours, when all died, though caught and treated with great care. A number of specimens kept for a considerable time in a large aquarium passed into the *Heteronereis* state, but were all dead when first observed, and I have no evidence that they lived long in that state. I have, however, kept alive for weeks or months a number of specimens not in the *Heteronereis* condition and observed their habits. Put into a glass of sea-water they very soon secreted a semi-transparent tube, which they sometimes deserted and formed another. I kept some with a moderately large piece of *Ulva latissima*. In this they secreted a tube open at both ends, from which they came out when disturbed and went back again. They had nothing to feed upon but the *Ulva*, which they evidently eat, and their excrements were manifestly pieces of undigested *Ulva*. One, however, grew up to be a fine specimen full of eggs; and one day, when disturbed, it wriggled

about and voided eggs, which I mounted on a lantern-slide, and carefully estimated their numbers at about 20,000. It had not passed into the *Heteronereis* condition; but I have mounted specimens of smaller size obtained elsewhere which are in that state and yet are full of eggs. The female, 3 inches long, which laid the eggs was mounted in balsam, and in general appearance differs remarkably from those full of partially developed eggs.

Another peculiarity of *N. Dumerilii* is that the large specimens from the Orwell, when mounted in balsam, turn from a pale red to a dark brown, even when the blood-vessels are well preserved, so that it is not due to decomposition, but as though some unusual pale substance changed gradually into a dark brown one. In no other species of Chætopod have I seen such a change.

The only other Chætopod that I have seen swimming in considerable numbers near the surface is *Siphonostoma (Flabelligera) affine* (M. Sars). In several years, before and after 1890, this was so abundant in the Orwell, that many objects dredged up were covered by scores of individuals. I have never seen any elsewhere or in the Orwell since. Many left the bottom and came near the surface, where they wriggled about and were carried along by the tidal current, and this continued day after day. Many were full of eggs, which they voided when kept alive, and my impression was that when swimming they were dispersing their ova. This case is interesting because it differs so completely from what I have observed in the case of *Heteronereis*, and so easy to understand.

N. cultrifera.—Baron de Saint-Joseph, in his work on the *Polychæta* of the coast of France, describes fully the characters of the male and female *Heteronereis* of this species, but does not allude to the *Nereis* form so common in South Britain. This is remarkable because, though during the whole of the summer months I have collected large numbers on the coast of Essex, I never saw one in the *Heteronereis* condition. I may also say that none of my numerous mounted specimens contain ova. It is of course possible that their development and the change to *Heteronereis* may occur at a time of the year when I was not on the yacht, or occurs very rarely. Dr. Allen informs me that it does occur at Plymouth, but in much smaller numbers than the *Nereis*.

N. pelagica.—I have never obtained a single specimen of the *Heteronereis*, which occurs in some localities abundantly between tide-marks.

In addition to the three cases already mentioned, I saw a number of *Heteronereis*, probably of *N. Dumerilii*, swimming at the surface in the Colne at high water on the evening of May 23rd, 1885, and also a large species in the Orwell, probably *N. longissima*, at high water when fine and hot on May 24th, 1889; but no specimens were caught so as to make me sure of the species.

On the whole, then, during several months each year in summer for about twenty years, I saw only five cases in which large numbers of *Heteronereis*, certainly of two species, were seen swimming at the surface, or about one case for each species in eight years. Of course I was not constantly on the look out, and cannot say what happened during the night or when the sea was rough, and I was not always in places where it was likely to occur. Taking all these things into consideration, it is quite possible that this simultaneous surface-swimming in large numbers may occur every year. It evidently may take place in the early morning, at midday, or in the evening, and in the early, the middle, or the late part of the summer months. When it does occur, it is such a striking spectacle that it seems worthy of being recorded. Unfortunately I have never been able to observe any facts which afforded a satisfactory explanation of the occurrence. My observations agree well with what has been seen at Plymouth. Dr. Allen informs me that in April 1885 numbers of the *Heteronereis* of *Nereis longissima* were seen by Dr. Jonathan Herder, but nothing of the sort in later years. The *Nereis* form is found in the mud at Salcombe, of about the same size as in the Orwell.

Nereis diversicolor occurs more or less abundantly in all the estuaries of Essex, Suffolk, and Kent. In preparing specimens for permanent mounting, I have been much struck with the remarkable difference in behaviour of those obtained in different localities. In St. Osyth Creek they abound in the mud left dry when the tide is down, and when kept in sea-water to which a few crystals of menthol were added the animals were soon stupified, and after a while did not revive when restored to water free from menthol, but died. In the mud of the Crouch near Burnham this same species is so rare that few can be obtained in the course of several hours. On keeping these with menthol, it seemed to have little or no effect. Chloral hydrate also failed to kill them, and to do this I had to use such a very poisonous substance as

cyanide of potassium. The conclusion I formed was that for some reason or other, perhaps the greater salinity of the water, the conditions at Burnham were so adverse as to have developed a specially hardy race, which could withstand what easily killed those living under more favourable conditions. Nor is this all. When 16 years ago I first began to prepare and mount marine animals in balsam as lantern-slides, and took very little care, I mounted a specimen of *N. diversicolor* from the Queenborough district which shows no trace of decomposition anywhere, and the minute blood-vessels of the parapodia are most unusually well preserved, filled with red blood. I have since preserved or tried to preserve many specimens from the Orwell and the Colne estuary, and, even when using much care, I found that in drying it was very difficult to prevent decomposition setting in from one cause or another, and even in my most successful preparations the blood-vessels are well preserved only here and there. It thus seems that, even when dead, specimens from different localities may differ much in the power of resisting decomposition; animals of the same species thus varying in physiological and chemical characters. I may also say that the relative amount of hæmoglobin differs enormously, some being deep red and others quite pale.

On the Membranous Labyrinths of *Echinorhinus*, *Cestracion*, and *Rhina*. By CHARLES STEWART, LL.D., F.R.S., F.L.S.

[Read 1st March, 1906.]

(PLATE 44.)

ECHINORHINUS SPINOSUS. Fam. Spinacidæ. (Pl. 44. fig. 1.)

THE fish upon which this dissection was made was 227 cm. (7 ft. 6 in.) in length. The utricle showed the usual complete separation into anterior and posterior portions, between which lay the ductus endolymphaticus passing upwards directly to a point immediately beneath the skin, where it passed backwards and enlarged into a pigmented, somewhat rugose distensible chamber, 15 mm. in length and 4 mm. in breadth. From the posterior superior angle of this a minute continuation passed upwards and slightly backwards through the skin to the apertura externa. The anterior utricle and the recessus com-